Exploring young children's (mathematical) thinking: preservice teachers reflect on the use of the one-to-one interview

Elizabeth Dunphy*

Education Department, St Patrick's College of Education, Dublin, Ireland

(Received 2 July 2010; final version received 7 October 2010)

One-to-one interviewing is one of the most powerful ways of exploring young children's thinking. While there are a few studies which report the use of this pedagogic strategy by preservice teachers, more are needed. This paper describes an early childhood mathematics education assignment which preservice teachers in a teacher-education college in Ireland undertake with four- and five-year-old children. It presents an analysis of data from a selected sample of 58 preservice teachers' reflections on their dialogues with individual children. It describes how the preservice teachers engaged with the process of interviewing the children; how they reflected on their interactions with the children; their reflections on the children's engagement; and their reflections on young children's mathematics generally. Some dilemmas faced by the participants in the course of the interviewing are highlighted. Findings demonstrate the integrated nature of the knowledge that early childhood teachers need to teach early childhood mathematics effectively. The learning arising from this assignment relates to early childhood mathematics thinking, to the psycho-social nature of learning in early childhood and to pedagogy in early childhood education.

Keywords: one-to-one interviewing; mathematics; story; reflection; children's agency

Introduction

Research identifies a number of changes that preservice teachers need to engage in to ensure the effective transition to teacher (e.g. McNamara, Webb, and Brundrett 2010). These include unlearning their pupil perspective to develop a teacher identity; changing beliefs and attitudes; enhancing curricular knowledge; transforming subject knowledge into pedagogical content knowledge; and developing pedagogic and reflective skills. Experiences which appear to promote such critical development are worthy of close scrutiny. This paper describes an early childhood mathematics education assignment in which preservice primary teachers in one of the main teacher-education colleges in Ireland undertake one-to-one interviewing with young children. It presents findings related to the way in which the preservice teachers engaged with the process of interviewing the children; how they reflected on their interactions with them; their reflections on the children's engagement; and their reflections on young children's mathematics generally. The aim of this paper is to

*Email: elizabeth.dunphy@spd.dcu.ie

contribute to professional knowledge for early childhood mathematics teaching by sharing this approach to the development of preservice teachers' early childhood mathematics pedagogy, and to offer it for use and modification by others (Snow 2001).

One-to-one interviewing of children in early childhood mathematics education

Interviewing is one of the most powerful ways of exploring young children's thinking and assessing their learning and development (e.g. Bowman, Donovan, and Burns 2001). Almost a decade ago the National Association for the Education of Young Children (NAEYC) and National Council of Teachers of Mathematics (NCTM) issued a statement on early childhood mathematics which emphasised that a critical element of high-quality mathematics education is the illumination of young children's mathematical thinking through sensitive and appropriate assessment approaches (NAEYC/NCTM 2002). Key amongst these approaches is interviewing. In interviewing, a pedagogy of listening (Rinaldi 2005) can be developed. This can be defined as being open to children's thinking and their theories and to using what is learned to shape future provision for learning and development.

The original one-to-one interview, sometimes referred to as the clinical interview, has been developed as a method over the years since first used by Piaget (1929/1997). Many variants of the original clinical approach are used to elicit children's ideas on a range of issues (e.g. Doverberg and Pramling 1993). The approach has been extensively applied and refined in early childhood mathematics (e.g. Eriksson 2008; Ginsburg 1997; Steffe et al. 1983; Wright, Martland, and Stafford 2006). One feature that the variants share is that they are dialogic in nature. The flexibility of the method means that the interviewer is free to respond by altering aspects of the task or the question as fitting. In other words a degree of intersubjectivity or shared thinking (Rogoff 1990, 1998) is developed through sustained engagement between teacher and child in a one-to-one situation. It is argued that one of the strengths of the interview method is that it can be used to assess both cognitive and affective aspects of children's understandings, including disposition (Dunphy 2005).

Many of the recently developed reform efforts in early childhood mathematics learning and teaching incorporate the use of one-to-one interviews with children as a central aspect of their projects because this method enables teachers to learn about the teaching and learning of early mathematics (Sarama and Clenments 2009). The practice of interviewing young children in the area of mathematics arises, in some respects, from the need to devise ways of studying young children's mathematical development without relying on written communication (Anderson, Anderson, and Thauberger 2008). For instance, in the USA the Big Math for Little Kids curriculum (Ginsburg, Galanter, and Morgenlander 2004) includes interviewing and analysis of the interview as part of the teacher-education workshops. The pioneering Early Numeracy Research Project, begun over a decade ago in Australia, incorporates one-to-one interviews by practicing teachers as a major feature of the project and this has proven to be highly successful in terms of teacher learning (e.g. McDonough, Clarke, and Clarke 2002). This project has now developed into what has been described as a fairly systematic and prolonged reform effort (Anderson, Anderson, and Thauberger 2008, 120).

The use of interviews by preservice teachers

As illustrated above, the case for teachers using interviewing as a method of assessment is well-made in the literature. In a recent synthesis of research, Sarama and Clenments (2009) note that in terms of professional development, prospective and preservice teachers both appear to benefit from an emphasis on learning how children learn mathematics. In Australia McDonough, Clarke, and Clarke (2002) noted the quality of information and insights gleaned about children and their learning by inservice teachers from one-to-one interviewing. This prompted them to incorporate the practice of this strategy into the curriculum for preservice teachers. They found that it offered significant benefits for preservice teachers in terms of their understanding of five- and six-year-old children's mathematical thinking and learning.

Learning about early learning in preservice teacher education

A compulsory 12-hour module on Mathematics in the Early Years at School is part of the first year of study for the three-year Bachelor of Education Degree (B.Ed.) at St Patrick's College of Education (Dublin City University). The majority of preservice teachers entering the course come directly to college from secondary school and very few have any teaching experience. The module on early childhood mathematics education is scheduled for immediately after entry to the course and is designed to challenge preservice teachers' thinking about young children, their learning and their abilities. It presents children as active and agentive (e.g. Bruner 1986) and emphasises how they learn to think and act in their culture as a result of interacting with adults and other people as they engage in everyday activity (Rogoff 1990, 1998). There is an emphasis on the fact that mathematical learning in the early years is often complex and abstract (e.g. Ginsburg and Ertle 2008).

The range of interactive strategies that support early learning and development are explored (e.g. Dowling 2005; National Council for Curriculum and Assessment 2009). The importance of careful listening for the possible meanings of children's contributions is emphasised, as is the importance of sustaining meaningful discussion (e.g. Clements, Sarama, and DiBiase 2004; Siraj-Blatchford and Sylva 2004; Tizard and Hughes 1984) in supportive and non-judgemental contexts (Houssart and Mason 2009). A key aim is the development of preservice teachers' awareness of the levels of shared meaning they establish with young children and of how to increase this through the styles of interaction adopted (e.g. Jordan 2009).

Exploring the mathematical thinking of young children

As was the practice in previous years, approximately 400 preservice teachers in their first semester in Year 1 of the B.Ed. degree in 2009–2010 were required to carry out the one-to-one interview. Most of them did so in Week 5 or Week 6. They were given written instructions, including the following:

(1) Interview the child using the questioning schedule provided as a guide (see Appendix 1). Transcribe the interview.
(2) Using the transcript as evidence, prepare a report analysing the child's thinking and the strategies s/he is using in relation to: sorting and classifying;

number and relative value of number (comparison); counting; and sharing. Comment on what the child did with the objects, what s/he said (either spontaneously or in response to a question). [700 words]

(3) Write a short narrative about your learning in relation to this assignment (see Appendix 2). [500 words]

Reflective practice (e.g. Schön 1983) is a pivotal emphasis in teacher education. Reflection on the interview requires preservice teachers to consider how they worked with the children. They consider what the child said and did, what the child might have been thinking and feeling. They also consider their responses to the child and the consequences of the responses for the way the dialogue unfolded. The intention is that through reflection they develop skills to articulate practice and to critique and develop it.

Aims

The aims of the assignment were to:

- demonstrate to preservice teachers the complexity of children's thinking;
- challenge their assumptions about young children and their learning;
- provide an opportunity to develop empathy with the child and so to take the child's view of the task;
- provide an opportunity to engage in sustained engagement with a four-year-old child on a one-to-one basis;
- illustrate to them the socio-cultural nature of learning and development;
- demonstrate for them the difference between children's participation in tasks as opposed to their performance on tasks;
- provide them with a model of how children's literature can be used to promote the teaching and learning of mathematics at school;
- exemplify for them good practice in the area of assessment of children's thinking; and
- engage them in reflection about their purposeful engagement with young children.

The structure of the interview

The assignment promotes the use of story to support the teaching and learning of mathematics in infant classes. The traditional story of The Three Billy Goats Gruff, provides the context within which the dialogue takes place. With previous cohorts the story of Goldilocks and The Three Bears provided the context. The story of how the three billy goats tricked the troll that lived under the bridge is shared and discussed. An alternative ending to the story is then suggested to the child:

> The troll ran from the bridge and made his way home. He felt sad and unhappy because of the way he had frightened the three Billy Goats Gruff. He thought of ways that he might make it up to the goats. He finally hit on a great idea. He would send them a present! A box of goodies!

During the course of the dialogue which follows the preservice teacher poses specific problems and related questions. These are such that they require the child to engage in describing, arranging, sharing and distributing the contents of the box which contains the following items: six biscuits, eight smarties, three mini-books of different sizes and colours, two small toys, seven coins (3 x 1c, 2 x 5c,2 x 10c) and three cards each containing some stickers (one, a few, lots). The intention is to elicit the child's mathematical thinking and to uncover the various mathematical strategies being used by the child.

A protocol of seven tasks and accompanying questions for each task was provided (see Appendix 1). The preservice teachers were alerted to the possibility that children might address the tasks in unexpected ways and might explain and justify their responses with reference to non-mathematical idiosyncratic logic.

There is of course a tension between using an adult-directed question and answer format and seeking to establish a flexible and responsive format, though it is possible to do so (Dunphy 2005) and preservice teachers need to learn how to work with this tension. The questioning schedule provided the relative restricted repertoire which research suggests is needed for novices to operate successfully (Alexander 2010, 417). However, the schedule was offered as a guide for structuring the dialogue, rather than as a prescription. Preservice teachers were advised to develop a dialogue which focused the child on the tasks in hand but was also responsive to the child's contributions as appropriate. They were encouraged to establish shared meaning through exploratory conversation with the children (Rogoff 1998), rather than adopting a content/teacher-focused approach.

The study

The transcription of their dialogue with individual children provided the material for preservice teachers' analyses and reflections. The assignment was not envisaged as an assessment of children's ability in mathematics as such, but rather it was presented as an opportunity to explore a young's child's thinking as elicited in the context of a structured dialogue. Consequently, preservice teachers were assured that there were no 'wrong' responses from the child and that all responses should be seen as important since they were indicative of how the child perceived the task. The preservice teachers were oriented towards an approach in which they considered not just the child's responses in mathematical terms, but also in terms of how these reflected the nature of the child's interests, background and perspectives. It was anticipated that through participating in the interview, preservice teachers would be enabled to focus on the holistic nature of children's thinking and learning and the implications of that for specific aspects of their mathematical understanding. The focus for the interview was a child in the first months of school (i.e. aged four or five years) or a child who was four years of age but not yet started school. Ethical guidelines were provided and preservice teachers were advised to adhere strictly to these. They were required to obtain the written consent of the parent(s)/ guardian(s) to interview the child and to audio-tape the interview. They also obtained the agreement of the child to partake in the discussion and to the audio-recording. They were advised to provide an opportunity for children to hear themselves on tape at the outset, after which they should seek the child's agreement to the recording of the discussion. They were alerted to the need to take account of the power relations at work in the interview situation.

The Ethics Committee of the College in which the author works granted approval for this research. After the assignments were graded I approached the preservice teachers in the groups that I was teaching and asked them to participate in the research. I was conscious of the power relations at work, so when explaining to them the nature of the research, I emphasised that there would be no negative consequences for them should they decide not to give permission (Egan 2009). About 58 preservice teachers signed the form (59 were invited, but one declined).

Data and analysis

The preservice teachers' narratives of their learning provided the data for this study. The narratives were dialogic in nature but somewhat structured by the guidance given (see Appendix 2). This suggested that the story of their engagement with the child might include a focus on their surprises, reactions, challenges and observations. There was of course the possibility that participants, in writing the narratives, provided the type of comments that they considered would be approved of. However, the narrative accounts appeared to be honest and reflective.

The guiding principles used to analyse the data were those articulated by Denscombe (2007). The narratives were numbered from 1 to 58 for ease of reference. Then arising from the initial careful reading of the narratives a number of categories emerged and these were labelled. On further readings of the data the initial set of categories were examined, relabelled and extended as appropriate. This process of collapsing and relabelling was carried out a number of times before the final set of categories was arrived at. These are presented in Table 1 below. The assignment of data to categories was relatively straightforward. Less straightforward was the labelling of the categories themselves and this involved a few iterations before I was confident that the categories adequately and comprehensively reflected the data, particularly in situations where I had merged two categories to form one. The final categories were clustered under three themes:

- how participants engaged with the task of interviewing;
- their reflections on their interactions with the individual children and their success or otherwise in establishing shared thinking; and
- their general reflections on the children's mathematical thinking.

Findings are discussed below.

Findings

The findings related to each of three themes are presented in Table 1.

How participants engaged with the task of interviewing

About 47 of the preservice teachers commented positively in terms of their engagement with the task. They typically referred to the process of interviewing

Table 1. Preservice teachers' reflections on the use of the one-to-one interview.

Themes and categories (derived from 58 narratives)	Examples of preservice teachers' comments
Theme 1: the task of interviewing	
Increasing confidence in working with a young child (n=9)	I thought that although I was nervous at the start I gained confidence as the interview progressed. (N3) It gave me confidence in my own skills. (N58) I was slightly nervous before the assignment that [child] might not understand my instructions. From here on I was more relaxed. It boosted my confidence. (N34)
Feelings of worry and anxiety (n=13)	I must admit that when I first heard about this assignment, I was a little concerned about it. I had a number of central concerns, such as getting adequate responses from the child, maintaining his attention and even simply organising the interview. (N43) I found it quite difficult to forget that I was recording us speaking and it made me very conscious of what I was saying. (N6)
Feelings of nervousness (n=8)	At the start of the interview I was quite nervous and agitated as I don't have much experience working with children. (N11)
Surprise at aspects of children's engagement (n=10)	I was surprised that the child was very excited about the whole exercise, excited about the thought of helping me do my homework. (N20) She was very attentive and co-operative and for the most of it fully engrossed herself in the interview, but it was her random comments and the way in which anything could be distracting to her or could be turned into a different story that was unrelated was surprising … (N42)
Establishing the context for the interview (n=4)	Millie was not happy that a troll was sending a present to the goats as she knew that trolls are not real … she was not completely satisfied with this fact. (N15)
Recognising the benefits of listening and reflecting on the dialogue (n=15)	Having the interview on a tape was a great resource because afterwards when making notes I found things I had not picked up on when we were doing the interview. (P24) I must admit that I was a bit disappointed or even frustrated with myself on a few occasions when I listened back over the interview. There were two or three occasions when Aonghus was talking, but I in effect cut him off, interfering with another question or point. (N43) I noticed how much I actually spoke, instead of letting Cahill do as much talking as possible … I sometimes gave the answer in the question, leaving him simply to agree or disagree with what I had said. (N40) I was talking too much in order to keep it moving so that [James] wouldn't get bored. (N2) I think [Jade's] questions benefited me hugely to gain an understanding of how the child is thinking about mathematical concepts. (N49)

Table 1 (Continued)

Themes and categories (derived from 58 narratives)	Examples of preservice teachers' comments
Theme 2: establishing shared meanings	
Questioning the child (n = 43)	
Asking too many questions (n = 7)	At one stage I asked [Kaylin] five questions in a row without letting her speak … did I really expect her to give me five answers at once?. (N18)
	… asking Crea such an extensive amount of questions in such a short space of time did not give her a fair opportunity to truly think about the answer or how to do the task she was given. (N23)
Giving children too little time to think and answer (n = 14)	I don't think I gave Clodagh enough time after I asked her the questions. I think I was actually afraid to have a pause in the interview. Therefore I don't think I made the most of the interview. (N17)
	I realise that I did not encourage [Danielle] enough to speak more and accepted a lot of yes and no answers. I also believe when she didn't speak I filled the silence with further questioning instead of leaving her time to think and a chance to speak. (N41)
Struggling to explain the question (n = 13)	I felt that I may have confused Darragh a little bit … I think I could have explained to him more clearly. (N7)
	I should have found another way to explain the question so that [Brian] could answer it himself. (N10)
	I had to adjust my language to help the four-year-old understand me better. (N53)
	… my use of language was not as clear as it should have been for example 'That's us now'. As I am a native Irish speaker I will have to improve my usage of English in the future. (N5)
	… some of the questions I asked Tim were worded confusingly, and therefore simple questions became difficult for him to answer. (N27)
Improving the questioning (n = 5)	… after seeing her reactions to my initial questions I was able to refine them to help her. (N39)
	Holly required very little prompting. She understood almost everything I asked of her. On some occasions I prompted by rephrasing the question which I found to be very effective. (N42)
Responding to the child's contributions (n = 26)	I followed the questioning schedule given and tried to elaborate where at all possible. I must admit that I found this a bit challenging. Coming up with a thought-provoking question on the spot that related to what was previously said is in my view quite tough. (N43)
	I answered by saying 'We'll get to the money in a minute'. If I was doing this again I would deal with Emma's question better by giving her an actual answer to her question … (N38)
	I think I was prepared with regard my notes and materials but I didn't expect the amount of questions that I got from Keelin. (N4)
	I was taken aback when he asked me the meaning of 'least' and 'second' and had to take a moment to consider how to answer him. (N3)

Table 1 (Continued)

Themes and categories (derived from 58 narratives)	Examples of preservice teachers' comments
	At one point during the interview the child started to ask me the questions so there was in a sense a reversing of roles. I think that this is because the child didn't see me as a teacher. I feel this is something I need to work on. (N37)
	While we were sorting out the sets of objects Emma had her heart set on having a show. I tried my best to distract her by saying that we would have a show at the end. She brought it up once more … (N38)
Being aware of power relations (n = 4)	Looking back I believe she only agreed with me because she thought it was the right answer since I was saying it. At times I think she didn't actually know if it was right or wrong … I now know that my questioning style must be changed … so that they realise they shouldn't always have to agree with me. (N18)
	I noticed a few … that the child looked for my opinion before she gave me hers. She wanted to say what she thought I wanted to hear. (N4)
Theme 3: children's mathematical thinking	
Surprise at what children knew or didn't know (n = 31)	I did not expect [Cria] to have mastered the five principles of counting at such an early stage in her primary education. (N23)
	I was greatly surprised at how much Freya knew. As she is not yet in school I did not expect her to know so much and to give such logical reasons for some of her answers. (N13)
	I was shocked when Aimee instantly knew the answer to the question 'How many biscuits do each of them get?' At this point, I wasn't well enough prepared to elicit her thinking because my expectations of her were lower than what they should have been'. (N19)
	… there were a few questions which contained the word 'least'. Each time I asked Michael these questions he got the answer wrong. He then informed me that he did not know what the word 'least' meant. Once I re-phrased the question Michael got the correct answer without hesitation. (N36)

as challenging and exciting (e.g. N37); interesting and productive (e.g. N56); thought provoking (e.g. N26); and rewarding (e.g. N22). The following comment was typical of several wherein participants indicated awareness of learning on several levels:

> The assignment was a fantastic opportunity to get an insight into a child's approach to learning and I also felt it was a great learning experience myself as I was able to reflect and look back on my interaction with Katie's learning. (N54)

In her study of the reactions of preservice teachers in England to focused small-group or one-to-one interactions with young children, Egan (2009) found similar reactions to that above.

The interview did pose a range of challenges for the preservice teachers. As can be seen from Table 1, some had negative feelings to overcome and in a few cases difficulties in establishing the task-context with the child. Quite a few (nine) of the preservice teachers wrote about how they felt that the interview improved their levels of confidence in working with young children. Over one quarter (n) of participants explicitly reported on the benefits of listening again to the dialogue they had with the child, as they did the transcription. Essentially they engaged in the kind of listening and reflecting activity documented by Paley (1988) and more recently promoted in the Reggio Emilia approach to early childhood education (e.g. Rinaldi 2005). The process of listening and transcribing appeared to enable the participants to reconsider some of the responses given by the children and their own responses to these.

Preservice teachers' reflections on their interactions with the individual children and their success or otherwise in establishing shared thinking

Findings suggest that the participants appreciated the importance of the act of questioning and of attending to children's answers and acting with these (e.g. Alexander 2003). Over two-thirds of participants commented in one respect or another on the extent and nature of the questioning that they used with the children. As can be seen from Table 1, some preservice teachers noted how they tended to ask too many questions and to give too little time to children to think and respond. Some noted how they struggled to express the question in a way that the child could understand. On a more positive note, a small number of respondents (five) explicitly noted improvements in their interactions with children as the interview progressed. In an Australian study, preservice teachers there also commented favourably on the power of the one-to-one interview in developing approaches to effective questioning and in eliciting children's thinking (McDonough, Clarke, and Clarke 2002). However, unlike the Australian respondents, concern by preservice teachers here was primarily with the way in which they reacted to children's responses.

About half of respondents commented on their lack of responsiveness in dialogue to children. Alexander (2003) comments on the need for careful management of the dialogue by teachers in order to elicit children's ideas and thinking. These comments are echoed in the comments of the participants (see Table 1) who showed an acute awareness of this aspect of dialogic discussion. For example, one preservice teacher commented:

> I had no time to read questions off my sheet or reading notes but this made the conversation more natural and I could pay attention to observing his reactions and comments. (N24)

Issues that arose in establishing the tone or tenor of the interview were commented on by several participants. For example:

> After I called out my student number [James] thought of what list of numbers would relate to him, so he called out his phone number. (N2)

This comment gave rise to much discussion later in class!

Some narratives indicated that the participants were still working from traditional concepts of the teacher/child roles in discussion:

> At one point during the interview the child started to ask me the questions so there was in a sense a reversing of roles. I think that this is because the child didn't see me as a teacher. I feel this is something I need to work on. (N37)

As can be seen from Table 1, a few participants indicated their awareness of the power relationships that were at work during the interview and the consequent difficulty of establishing a dialogue (Alexander 2003).

Preservice teachers' general reflections on the children's mathematical thinking

More than half of the participants expressed surprise at children's mathematical thinking as conveyed in their talk and in their actions. Many of the comments related to this theme were consistent with those of the preservice teachers in the Australian study (McDonough, Clarke, and Clarke 2002). What both sets of preservice teachers shared was their emphasis on how the one-to-one interviewing enabled them to gain insights into how young children think when doing mathematics and to understand how theory (as encountered in the coursework) looked in practice. Again consistent with the Australian study cited above, a number of participants also commented that they were surprised at what children appeared to find difficult. Children's logic also gave rise to some comment. For instance:

> [Orla] gave the smallest Billy Goat Gruff the middle sized card of stickers because she liked them. She gave the biggest Billy Goat Gruff the card with the most stickers but her reason was because they were Christmas stickers. (N33)

As the children participated in the interviews their interactions and responses were seen by many of the participants to be grounded in, and influenced by the events, and issues in the everyday lives of the children:

> Michael is very aware of the mathematics going on in the world around him. . .

In developing this point the participant described how the child used a reference to the housing arrangements for the calves on his Dad's farm to explain his knowledge that four and four is eight:

> Michael father is a dairy farmer and when the calves are separated from their mothers they're housed up in the shed in groups of four. Michael therefore has had plenty of practice in counting multiples of four with his father. . . (N29).

Another participant reported that:

> While we were working with the money Collette paid special attention to the 5c coin. (N55)

In the narrative the participant further commented on the fact that the child then went on to say that her age at her next birthday was five.

Dilemmas and tensions evident from the narratives

One dilemma that arose for the participants was that of dealing ethically and respectfully with children's wishes as conveyed by them during the course of the dialogues. When children either explicitly or implicitly indicated that they wished to cease the discussion and where participants picked up on this, they often expressed confusion and uncertainty as to how to act.

In one case the participant stated that the child asked that they stop talking about The Billy Goats Gruff. This raised a dilemma for the participant and this was articulated as follows:

> I found that [Sean] was getting quite tired and at one stage. . .I feel that I could have made my questions more interesting to keep his concentration. (N5)

> James used every excuse to try to distract me by talking about the farm and his family. This increased as the interview went on. He got tired of sitting down and concentrating on the one thing. . . (N2)

Some participants located a problem with the format they were using:

> [Ronan] announced he was tired. Perhaps this was my fault. I may have spent too much time introducing the task and towards the end he may have become bored. . .In the future I would try to re-engage the child by changing direction. . . (N45)

> Towards the end of the interview Grace began to show signs of restlessness. She was easily distracted and I had to keep her attention in the last few minutes. I think I may have asked too many questions. . . (N52)

Another participant noted:

> I found that Emma didn't understand the concept of first, second, third, fourth, etc. I could have gone on to explain this better but I felt Emma was tired at this point. . . (N38)

A second dilemma that was discernible in many of the responses was the unease that many of the participants noted they felt when they were presented with a 'wrong' response from a child. The following is typical in this respect:

> I was unsure as to whether or not to correct her, and I mainly just carried on with the interview. (N48)

Alexander (2003, 29), commenting on observed pedagogy in classrooms in England, reports how teachers glossed over 'wrong' answers. He argues against . . .classroom discourse which is warm and inclusive but cognitively undemanding, and which prefers bland and eventually phatic praise to focused feedback (30).

Assisting preservice teachers in learning to work with such dilemmas and to respond in ways that are respectful of children and of their capabilities and rights has to form a part of the preservice curriculum.

Improving the interview schedule

The preservice teachers' comments clearly indicate certain features of the assignment that might be improved on in order to enrich the experience for both them and the children. For instance the questioning schedule should be less prescriptive and it should better promote the idea that the preservice teacher needs to consider, on the spot, how best to develop the interactions based on the child's responses or comments. While such scope presently exists, it does not appear to be exploited by the preservice teachers, many of whom tend to adhere rigidly to the schedule. Redesigning it with less emphasis on the questioning (and less questions) and with more emphasis on establishing a dialogue would be useful. In this respect preservice teachers would benefit from more explicitly stated prompts in relation to the importance of following

the child's gaze, actions and verbal responses. Useful suggestions on the schedule might be to pause and wait for a child's response before rewording the question; to allow some silence in which the child can think; to consider the child's response and possible reasons for that response before commenting further; and using more open-ended statements such as 'I wonder' or 'Maybe'.

In relation to establishing the fantasy context it might be useful if preservice teachers were encouraged to preface the work with the statement 'Let's pretend'. This might clarify the context for some children.

It would add a great deal to the preservice teachers' reflections and analyses if they could focus on visual as well as audio records of the interactions. However, the use of audio-recordings as opposed to video is not accidental in the study presented here. It arises mainly due to concerns about securing parental permissions for video-recording by large number of preservice students (400 each year). Difficulties in ensuring that all requirements regarding child protection and ethics are adhered to should not be underestimated, particularly where large cohorts of students are involved. It has proven challenging to ensure that preservice teachers at St Patrick's College, just four weeks into their course of study, are fully aware of the issues related to child protection and ethics. At present they must seek parental permission to audio-tape the children. They themselves must sign a form stating that they are aware of the ethical guidelines within which they may work on this assignment. Ways of moving to video-recording of the preservice teachers' work with children is something that is certainly worth considering from a pedagogical perspective. Such records would provide the preservice teacher with a more holistic record of children's responses and the possibility for them of developing a better understanding of individual children's participation in tasks such as the one described in this paper.

Conclusions

This was a challenging assignment for the preservice teachers involved. Exploring children's mathematical thinking is complex in terms of pedagogy. To carry out the assignment it is necessary to integrate a range of new information, understandings and theories about young children, learning and teaching. But critically preservice teachers here were working in a situation in which they have not had an opportunity to establish the close relationship necessary to establish intersubjectivity (e.g. Whitington and Ward 1999) and wherein young children feel most comfortable in expressing their learning (e.g. Pramling 2004). The data presented here demonstrates that the assignment was very worthwhile in terms of preservice teachers' learning. It is a critical introduction to a way of working with young children.

The preservice teachers in this study, through their analyses of their efforts at coordination with children and especially through their efforts to establish mutual thinking and shared understanding, can be seen as developing and transforming their participation as preservice teachers (Rogoff 1998). This assignment can be viewed as a conscription device (Cowie and Carr 2009, 118) for establishing a community of early childhood teachers with particular values and perspectives around young learners.

The process of one-to-one interviewing appeared to engage preservice teachers in two ways. On the emotional level fear, control, respect and surprise were all clearly discernible in the participants' reflective narratives. The process also engaged preservice teachers at an intellectual level. The findings here demonstrate that the

one-to-one interview offered an opportunity for preservice teachers to work towards promoting in children the sustained mindful engagement that is so crucial for learning in early childhood (James and Pollard 2010, 542). It challenged them to respond to children's agency. For some participants the act of reflecting on their role in discussion/dialogue raised some conflicts. The idea that learning is something that is engaged in by the teacher and child together is a novel idea for many of the preservice teachers in this study. Equally novel is the idea that for the promotion of learning, what children say matters more that what teachers say (Alexander 2003, 33). The preservice teachers in this study were required to reflect on their interactions with the children. This meant that they recognised and acknowledged some of the other unexpected aspects of the children's engagement. Writing the reflective narrative appeared to enable some participants to take a 'whole' view of children's learning, to consider children's responses in the wider context. They had the opportunity to see that understanding and appreciating children's responses requires an understanding and appreciation of their thinking; their efforts to make sense of the world; their efforts to connect their experiences; and to develop theories about the world based on those experiences.

Acknowledgements

I wish to acknowledge the collaboration of the members of the Early Childhood Education Team at St Patrick's College who over the years have worked together with me to develop this assignment. They include Maura O'Connor; Mary Kildea and Philomena Donnelly.

References

Alexander, R. 2003. Oracy, literacy and pedagogy: International perspectives. In Classroom interactions in literacy, ed. E. Bearne, H. Dombay, and Y. Grainger, 23–35. London: Open University Press.

Alexander, R. 2010. The Cambridge Primary Review Research Surveys. London: Routledge.

Anderson, A., J. Anderson, and C. Thauberger. 2008. Mathematics learning and teaching in the early years. In Contemporary perspectives on mathematics in early childhood education ed. O. Saracho and B. Spodek, 95–132. Charlotte, NC: Information Age. Bowman, B., S. Donovan, and S. Burns, eds. 2001. Eager to learn: Educating our preschoolers. Report of Committee on Early Childhood Pedagogy, Commission on Behavioral and Social Sciences and Education National Research Council. Washington, DC: National Academy Press.

Bruner, J. 1986. Actual minds, possible worlds. Cambridge, MA: Harvard University Press.

Clements, D., J. Sarama, and A. DiBiase, eds. 2004. Engaging young children in mathematics: Standards for early childhood mathematics education. Mahwah, NJ: Lawrence Erlbaum.

Cowie, B., and M. Carr. 2009. The consequences of sociocultural assessment. In Early childhood education: Society and culture, 2nd ed., ed. A. Anning, J. Cullen, and M. Fleer, 105–16. London: Sage.

Denscombe, M. 2007. The good research guide for small scale social research projects, 3rd ed. Maidenhead, Berkshire: Open University Press.

Doverberg, E., and I. Pramling. 1993. To understand children's thinking: Methods for interviewing children. Gothenburg: Department of Methodology, University of Gothenburg Report No. 5.

Dowling, M. 2005. Young children's personal, social and emotional development, 2nd ed. Columbus, OH: Pearson.

Dunphy, E. 2005. Ethical and effective interviewing of children in pedagogical contexts. European Early Childhood Education Research Journal 13, no. 2: 79–96.

Egan, B. 2009. Learning conversations and listening pedagogy: The relationship in student teachers' developing professional identities. European Early Childhood Education Research Journal 17, no. 1: 43–56.
Eriksson, G. 2008. Arithmetical thinking in children attending special schools for the intellectually disabled. Journal of Mathematical Behaviour 27, no. 1: 1–10.
Ginsburg, H. 1997. Entering the child's mind: The clinical interview in psychological research and practice. New York: Cambridge University Press.
Ginsburg, H., and B. Ertle. 2008. Knowing the mathematics in early childhood mathematics. In Contemporary perspectives on mathematics in early childhood education ed. O. Saracho and B. Spodek, 45–66. Charlotte, NC: Information Age.
Ginsburg, H., M. Galanter, and M. Morgenlander. 2004. Big maths for little kids workshops. New York: Teachers College Innovations.
Houssart, J., and J. Mason. 2009. Listening counts: Listening to young learners of mathematics. Stoke on Trent: Trentham Books.
James, M., and A. Pollard. 2010. Learning and teaching in primary schools. In The Cambridge Primary Review Research Surveys, ed. R. Alexander, 525–47. London: Routledge.
Jordan, B. 2009. Scaffolding learning and co-constructing understandings understanding. In Early childhood education: Society and culture, ed. A. Anning, J. Cullen, and M. Fleer, 31–42. London: Sage.
McDonough, A., B. Clarke, and D. Clarke. 2002. Understanding, assessing and developing children's mathematical thinking: The power of a one-to-one interview for preservice teachers in providing insights into appropriate pedagogical practices. International Journal of Educational Research 37: 211–26.
McNamara, O., R. Webb, and M. Brundrett. 2010. Primary teachers: Initial teacher education, continuing professional development and school leadership development. In The Cambridge Primary Review Research Surveys, ed. R. Alexander with, C. Doddington, J. Gray, L. Hargraves, and R. Kershner, 649–701. London: Routledge.
National Association for the Education of Young Children and National Council of Teachers of Mathematics. 2002. Early childhood mathematics: Promoting good beginnings. http://www.naeyc.org/about/positions/pdf/psmath.pdf (accessed June 6, 2007).
National Council for Curriculum and Assessment. 2009. Aistear: The early childhood curriculum framework. Dublin: NCCA. http://www.ncca.ie (accessed January 9, 2010).
Paley, V.G. 1988. Bad guys don. t have birthdays: Fantasy play at four''. Chicago, IL: University of Chicago Press.
Piaget, J. 1929/1997. The child's conception of the world. Trans. Joan and Andrew Tomlinson. London: Routledge.
Pramling, I. 2004. How do children tell us about their childhoods? Early Childhood Research and Practice 6, no. 1. http://www.ecrp.uiuc.edu/v6n1/pramling.html (accessed August 8, 2006).
Rinaldi, C. 2005. In dialogue with Reggio Emilia: Listening, researching and learning. London: Routledge-Falmer.
Rogoff, B. 1990. Apprenticeship in thinking: Cognitive development in social context. New York: Oxford University Press.
Rogoff, B. 1998. Cognition as a collaborative process. In Handbook of child psychology, 5th ed, ed. W. Damon, 679–744. New York: John Wylie.
Sarama, J., and D. Clenments. 2009. Early childhood mathematics education research: Learning trajectories for young children. New York, NY: Routledge.
Schön, D. 1983. The reflective practitioner: How professionals think in action. London: Temple Smith.
Siraj-Blatchford, I., and K. Sylva. 2004. Researching pedagogy in English preschools. British Educational Research Journal 30, no. 5: 713–39.
Snow, C. 2001. Knowing what we know: Children, teachers, researchers. Educational Researcher 15, no. 2: 4–14.
Steffe, L., E. von Glasersfeld, J. Richards, and P. Cobb. 1983. Children's counting types: Philosophy, theory and application. New York: Praeger.
Tizard, B., and M. Hughes. 1984. Young children learning talking and thinking at home and at school. London: Fontana Paperbacks.

Whitington, V., and C. Ward. 1999. Intersubjectivity in caregiver-child communication. In Landscapes of development: An anthology of readings, ed. L.E. Berk, 109–22. Belmont, CA: Wadsworth.
Wright, R., J. Martland, and A. Stafford. 2006. Early numeracy: Assessment for teaching and intervention, 2nd ed.. London: Paul Chapman.

Appendix 1. Interview schedule

Questioning schedule

Please note: This is a guide in relation to questioning. However, your questioning should be responsive to the child so do base your questioning and comments on the child's responses.

Take out the contents of the gift-box and lay them on the table.
Have the three soft toys sitting on the table also, watching.

1. Let's tidy these so that the things that are alike are together.
   Possible prompts.
   Now, what things go together? Why?
   Oh, you've made a group of . . .!/Tell me about your group.
   What might we put with this? Why?
   Why did you put these together?
   Is there anything else that can go with this? Why?
   Could we put this into another group? Why? Why not?
   Could we make different groups?
   Which is the biggest group? Smallest?
   Draw the child's attention to the little books.
   Place these together.
2. I wonder did the troll send enough books for each of the goats?
   Why do you say that?
   How do you know?
   Which book should we give to Little Billy Goat Gruff? Middle-Sized Billy Goat Gruff? Great Big Billy
   Goat Gruff?
   Draw the child's attention to the toys.
   Place these together.
3. Do they have a toy each?
   Why do you say that?
   Can you check?
   How many more do we need for all the goats to have a toy?
   Draw the child's attention to the eight sweets.
   Lay them out on the table in a random arrangement.
4. The goats love sweets. Take a quick look and tell me how many there might be on the table here.
   How do you know?
   Can we check? [Do you need to put them in a line for the child?]
   Draw the child's attention to the six biscuits.
   Lay them out on the table in a random fashion.
5. The goats are hungry for the biscuits.
   How many do you think there are?
   How do you know?
   Can you check?
   How many will they each get?
   How do you know?
   Show me/Can you check?
   Is this fair?
   Draw the child's attention to the sticker pictures.
   Lay them out on the table and look closely at each one.

6. Which one would you pick?
   Why do you say that?
   Which one has the most? How do you know?
   Which one has the least? How do you know?
   Which one should Little Billy Goat Gruff have? Middle-Sized Billy Goat Gruff? Great Big Billy Goat
   Gruff? Why?
   Draw the child's attention to the coins.
   Lay them out on the table in front of the child.
7. What one would you pick?
   Why do you say that?
   Which ones are the same? How are they the same?
   Which will we give should we give Little Billy Goat Gruff? Middle-Sized Billy Goat Gruff? Great Big
   Billy Goat Gruff? Why?
   Now, who has the most?
   Who has the least?
   Which bundle would you like? Why?
   To finish, play a little game with the child.
   Select five different objects and lay them out of the table in a line.
   Encourage the child to identify the ordinal position of the objects.
   Which one is First? Second? Third? Fourth? Fifth? Last?

Important note:
It is important that you try and use a variety of strategies to enable the child to extend his/her responses. Ask him/her to explain, reason and justify where appropriate. Think about how you might do this!!

Appendix 2. Ethical guidelines

Ethical considerations

- Give parent(s)/guardian(s) a brief description of what your assignment entails. Ensure that you have their signed permission before you conduct the interview.
- Explain the purpose of the interview to the child i.e. to help you with your work for college. It is very important that the child knows that s/he is being recorded and that it is not done covertly. It is a good idea to familiarise the child with the tape recorder before the interview (perhaps by inviting him/her to speak and then replay before the interview formally begins).
- Choose the location for the discussion in consultation with the child and the child's parents. It is strongly recommended that the family kitchen/sitting room is ideal for your work since you can engage in an uninterrupted way with the child, yet family members are nearby. Please note that the child's bedroom is not a suitable location in which to conduct the project.
- Whilst occasionally the child's parents/guardians may request that they be present during the interview, it is important they realise that it is part of your project to elicit the child's thoughts, ideas and responses and that any interventions or interjections from them may be confusing for the child, and likewise may affect the validity of your work.
- You must make sure that nothing you say or do results in negative consequences for the child. At all times ensure that the child's self-esteem is protected and that you respect the efforts the child makes on your behalf.

In formally reported reporting your work, it is important that you preserve the child's identity at all times. For example, do not give the child's surname or other such details in your report.

This is accompanied by a letter to parents explaining the purpose of the assignment. The letter also explains the requirement to use audio-tape to record the discussion with the child. Parental permission is requested and a signature is required.